FAX/DATA MODEM
USER'S MANUAL

Notice:

Hayes is a trademark of Microcomputer Products Inc.

Publication Number : ASK9406

Table of Contents

FCC/DOC REQUIREMENTS i
- FCC General Information i
- FCC Notice i
- DOC Notice III

INTRODUCTION 1

COMMAND REFERENCE 3
- General Command information 4
- AT Commands 4
  - Commands Preceded by & 11
  - Commands Preceded by \ 17
  - Commands Preceded by % 23
  - Commands Preceded by-and " 25
- Dial Modifers 26
- Time Independent Escape Sequence (TIES) 29
- Result Codes 31

S REGISTER REFERENCE 35
- Register Summary 36
- Glossary of the S Registers 38

TESTING 53
Local Analog Loopback 53
Local Analog Loopback with Self-Test 56
Remote Digital Loopback 57
Remote Digital Loopback with Self-Test 59
Local Digital Loopback 60
Grant or Deny RDL Request from Remote Modem 62

TROUBLESHOOTING GUIDE 63

APPLICATION EXAMPLES 67
Dialing a Remote Modem 67
Dial a Stored Number 67
Manual Answer an Incoming Call 68
Auto Answer an Incoming Call 68
Voice to Data Switching 69

TECHNICAL SPECIFICATIONS 71
Features 71

QUICK REFERENCE 75

ASCII CODE TABLE 79

i - FCC/DOC REQUIREMENTS

i.1 FCC General Information

The Federal Communications Commission (FCC) of the United States restricts specific uses of modems, and places registration responsibilities on both the manufacturer and the individual user:

1. The modem may not be connected to a party line or to a coin operated telephone,

2. The modem manufacturer must make any repairs to the modem to maintain valid FCC registration.

3. Notification to the telephone company is no longer required prior to connecting registered equipment, but upon request from the telephone company, the user shall tell the telephone company which line the equipment is connected to as well as the registration number and ringer equivalence number of the registered protective circuitry FCC information is printed on a label on the bottom of the modem.

i.2 FCC Notice

This equipment has been tested and found to comply with the limits for a digital device, pursuant to Subpart B of Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and uses radio frequency energy and if not in-

stalled and used the instructions. may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation, If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a curcuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Shielded interconnect cables and a shielded power cord must be employed with this equipment to insure compliance with the pertinent RF emission limits governing this device. Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

NOTE : The manufacturer is not responsible for any radio or T.V. interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

i.3 DOC Notice

Notice: The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection, In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions. may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe System if present, are connected together. This precaution may be particularly important in rural areas,

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority. or electrician, as appropriate.

The Load Number (LN) assigned to each terminal device denotes the percentage or the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may" consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100.

1- INTRODUCTION

Congratulations on your purchase of this outstanding Fax/Data Modem. This manual describes how to operate your new Fax/Data Modem.

Instructions for installing your Fax/Data Modem will be found in the Installation Manual, while the information in this manual, deals exclusively with the operation of the modem after it is installed, such as the command set, the internal configuration registers, troubleshooting and testing.

Features :

These Fax/Data Modems combine the features of a 14400 bps data modem and a 14400 bps FAX modem. Your new Fax/Data Modem gives your personal computer the ability to send and receive FAX messages over the telephone line like a standard FAX machine. Your Fax/Data Modem also allows your PC to communicate with other personal computers, terminals or BBS's (Bulletin Board Systems) through the data modem functions,

When used as a data modem your Fax/Data Modem uses the standard AT command set and is fully compatible with CCITT V.42, V.42bis, V.32bis, V.32, V.22bis, V.22, V.21, MNP 2-5, Bell 103 and 212A. When used as a Fax/Data Modem it communicates with all CCITT Group 3 FAX machines and is compatible with CCIIT V.27ter and V.29, V 17, T.4 and T,30. Switching between DATA mode operation and FAX mode operation of your Fax/Data Modem is done through its firmware, no hardware settings are required.

If you are already familiar with the use of a modem and the Hayes AT command set, this modem will be extremely easy for you to use. Just read the installation procedures in the installation manual and you are ready to begin operation. If you are new to modem communications, we recommend that you read through this manual first. If you come across terms that you don't understand. consult the glossary. Words in boldface type are command names, commands. or default settings. Carnage returns (Enter) are noted with <CR> or [ENTER]; this does not mean to enter these characters literally; but instead to press the Enter key.

This manual is written to be used for several models of Fax/Data Modems. Some of the information in this manual may not apply to your fax/data modem.

2- COMMAND REFERENCE

This chapter provides an alphabetized reference with examples for all commands for the modem. The system of commands is depicted below in Figure 2-1.

To use these commands for dialing or configuring the modem, make sure the communications software package you will be using lets you operate the modem through its internal commands. If your software permits use of the modem's internal commands, read this chapter. If not, read your software user's manual and ignore the rest of this manual.

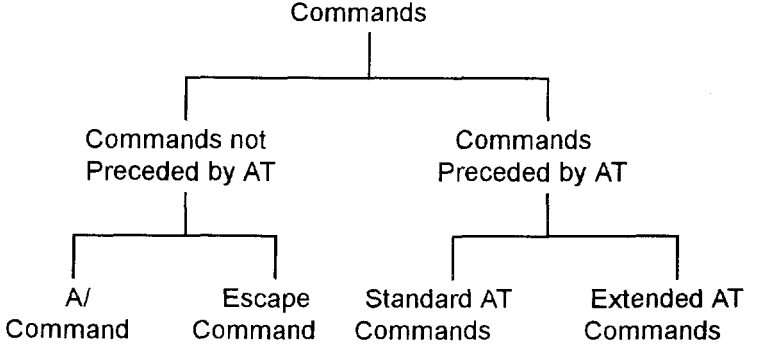

Fig. 2-1 System of Commands

2.1 General Command Information

Except for the A/ command and the TIES escape sequence described in Section 2.4, all commands must be prefixed with the attention code **AT.** For instance, the A command (below) would be entered as: **"AT A <CR>".** Without the **AT** prefix, the command line cannot be executed. Once entered, AT cannot be deleted with the Backspace or Delete keys.

More than one command can be placed on a single line and, if desired, separated with spaces for readability. Once the carriage return **(Enter)** key is pressed, the command line is executed. Aline with no carriage return is ignored.

The modem accepts either upper or lower case characters in the command line and ignores any spaces within or between commands. Typing errors can be corrected with the Backspace key. Exceptions are noted in the description of specific commands.

A command without any parameter is eqivant to that the parameter 0 is being used, for example, the command line ATL is equal to **ATL0.**

2.2 AT Commands

A/ Repeat Last Command

This command re-executes the last 'AT' command string stored in the command

buffer. The A/ command is the only command not preceded by 'AT' and ended by a carriage return.

A Go On-line in Answer Mode

This command instincts the modem to go off-hook immediately and then make a handshake with the remote modem. Handshaking is not available during leased line operation. This command is useful for manually answering a call or establishing a back-to-back connection with an originate mode modem.

Bn Select Protocol to 300 bps or 1200 bps

B0	Selects CC ITT 300 or CC ITT 1200 protocol once the command line prefix AT has been entered at the 300 bps or 1200 bps data rate,
B1	Selects BELL 300 or BELL212A protocol once the command line prefix AT has been entered at the 300 or 1200 bps data rate. (default)

Cn Carrier Transmit Control

Controls the transmit carrier. The modem is preset to turn carrier on and off as necessary (the C1 option). The signal is on when the modem is calling, or connected to a remote modem, and is off when it is not. The CO option is NOT valid.

C0	Not permitted; returns ERROR result code
C1	Normal transmit carrier switching. (default)

D Go On-line in Originate Mode

D instructs the modem to go off-hook immediately and automatically dial the number contained in the dial string following D. The dial string may contain any of the dial modifiers contained in the following section. The D command without a dial string is usually used to switch from voice conversation to data communication or to call a remote modem in leased-line operation mode. During this kind of operation. the dial tone monitor should be disabled with the X0, X1, or X3 commands.

En Command Echo

E0	Disables command echo.
E I	Enables command echo. (default)

Fn On-line Echo

This command is normally used to select whether the modem echoes data back to the host during on-line data mode. This device set does not support on-line data mode echo,

F0	Echo enabled. (returns an error message)
F1	Echo disabled. (default)

Hn Hang Up

HO	Goes on-hook. (hangs up)
H1	Goes off-hook. (ready to dial)

In Identification/Checksum Option

This command causes the modem to send product code and hardware setup information to the DTE.

I0	Report product code. (default)
I1	Firmware version #.
I2	Verify ROM checksum.
I3	Device set name.
I4	Modem configuration.

Bit 0 0= Hayes Escape Sequence.
1 =TIES Escape Sequence,
Bit 1 0= Data/fax/voice without V.42/MNP firmware.
1 =Data/fax/voice with V.42/MN P firmware.
Bit 2 0= Serial host interface,
1 =Parallel host interface.
Bit 3 0=No external Static RAM present.
1 =External Static RAM present,
Bit 4 0=8K x 8 static RAM present. (valid only if bit 3 = 1)
1 =32K x 8 static RAM present. (valid only if bit 3 = 1)
Bits 5-7 Reserved

Kn Buffer Control

This command selects whether the modem SRAM is used for voice and fax mode,

K0	SRAM buffer disabled. (default when no SRAM is available)
K1	SRAM buffer enabled. (default when the SRAM is available on modem board) (default)

Ln Control Speaker Volume

L0	Low volume.
L1	Low volume.
L2	Medium volume. (default)
L3	High speaker volume.

Mn Monitor Speaker On/Off

M0	Speaker is always off.
M1	Speaker is off while receiving carrier. (default)
M2	Speaker is always on.
M3	Speaker disabled while dialing or receiving carrier

Nn Select Data Rate Handshake

This command specifies whether the resulting modem-to-modem data rate can be different than the local DTE-to-modem data rate.

N0	When originating or answering, handshake only at the DTE-to-modem data rate.
N1	When originating or answering, begin handshaking at the DTE-to-modem data rate. If the remote modem does not support the local DTE-to-modem data rate. fall down to the highest compatible data rate. (default)

On Return to the On-line State

Applies to asynchronous operation only. If the user enters the command mode from the data mode by issuing the escape sequence, or as a result of ON-to-OFF transition of DTR with the AT&D1 option in effect, the user may return to the data mode without terminating a call by issuing the ATO command.

O0	Causes the modem to return to the data mode. (default)
01	Enters on-line data mode with a retrain before returning to on-line data mode.

P Set Pulse Dial as Default

Causes the modem to assume that all subsequent dial commands are pulse dialed. You may omit the "P' from the dial strings.

Q Result Code Display

Determines whether the modem sends the result codes to the DTE.

Q0	Allows the modem to send result codes to the DTE. (default)
Q1	Prohibits the modem from sending result codes to the DTE.

Sn Reading and Writing to S Registers

Sn?	Reads S Registers: Reads the contents of the S register specified by 'n'.
Sn=x	Writing to Registers: Writes the value of x to the specified S register. All the registers will return the OK response if x is a legal value. (n= 0-30, x=0-255)

T Set Tone Dial as Default

Causes the modem to assume that all subsequent dial commands are tone dial.

Vn Select Word or Digit Result Codes

V0	Displays. result codes in digital format.
V I	Displays result codes in verbose format. (default)

Xn Select Result Codes

	X0	X1	X2	X3	X4(default)
Connect Message	Partial	Full	Full	Full	Full
Dialtone Monitor	Off	Off	On	Off	On
Busy Tone Monitor	**Off**	**Off**	**Off**	On	On

The partial connect message reports CONNECT, the full message reports CONNECT XXXX, where XXXX is the data rate.

Yn Enables or Disables Long Space Disconnect

Y0	Disables Long Space Disconnect. (default)
Y1	Enables Long Space Disconnect.

Zn Reset

Zn, **which** must be placed at the end of the command line, resets the active configuration of the modem to the stored configuration saved in nonvolatile RAM, hanngs up the modem. and clears the command buffer.

Z0	Resets the modem and loads stored configuration 0. (default)
Z1	Resets the modem and loads stored configuration 1.

2.2.a Commands Preceded by &

&Cn Select DCD Options

&C0	Maintains an ON status for the Data Carrier Detect. (DCD)
&C1	Uses the actual state of the carrier from the remote modem for DCD. (default)

&Dn DTR Option

This command controls how the modem responds to DTR, After toggling DTR, the host should wait 200 ms before modifying the UART registers or sending a new command to the modem as the modem does not send an 'OK' message to indicate it has performed the requested function.

&D0	In asynchronous mode (&Q0), the modem ignores DTR.
&D1	The modem switches from data mode to command mode when an on-to-off transition of DTR occurs.
&D2	An on-to-off transition of DTR causes the modem to go on-hook (hang-up) and disable auto-answer mode. Auto-answer mode (S0 is not equal to zero) is enabled when DTR is turned on. (default)
&D3	An on-to-off transition of DTR re-initializes the modem. The re-initialize procedure performs a power-up reset, except that the UART registers are not re-configured,
Note :	The modem will not respond to a DTR toggle in sleep or power down mode (see S-register S30) It is recommended that a character be sent to wake up the modem prior to toggling DTR.

&F Fetch Factory Configuration

This command loads command and S-register factory defaults into the active configuration, and configures the modem for data mode.

&Gn Set Guard Tone

&G0	Guard tone disabled. (default)
&G1	550 Hz guard tone enabled.
&G2	1800 Hz guard tone enabled.

&Jn Auxiliary Relay Control

This command is only included for compatibility and performs no function except to load the S-register.

&J0	&J0 command. (default)
&J1	&J1 command.

&Pn Select Pulse Dialing Make/Break Ratio

&P0	Sets a 39/61 make/break ratio at 10 pps. (default)
&P1	Sets a 33/67 make/break ratio at 10 pps.

&Sn DSR Option

This command controls how the modem treats the DSR signal.

&S0	DSR circuit always on. (default)
&S1	DSR circuit is on during handshaking, off in test or idle modes. DSR is on when carrier is lost.

&Tn Testing and Diagnostics (See Chapter 4)

This command is used 10 initiate and terminate loopback tests for testing modem-to-modem and DTE-to-modem data communication integrity.

&T0	Terminates test in progress. (default)
&T1	Local analog loopback.
&T3	Local digital loopback.
&T4	Grants RDL request from remote modem.
&T5	Denies RDL request from remote modem.
&T6	Remote digital loopback.
&T7	Remote digital loopback with self-test.
&T8	Local analog loopback with self-test.

&U Disable Trellis coding

This command selects whether the modem will transmit and receive modulated 9600 bps carrier with QAM or Trellis encoding for V.32.

Range: n = 0-1

&U0	Enabled. (Trellis modulation with QAM modulation as a fallback) (default)
&U1	Disabled. (QAM modulation only)

&Vn View Active Configuration and Stored Profiles

This command causes the modem to send command and S-register configuration information to the DTE for the following: the active user profile, and one of two stored user profiles.

&V0	Stored profile 0. (default)
&V1	Stored profile 1.

AT&V1

Active Profile:

+FCLASS=0 #VCL=0 #VLN=25
B1 E1 L2 M1 N1 P Q0 V1 X4 Y0 &C1 &D2 &G0 &J0 &P0 &Q0 &S0 &Y0-C0 %E1 %G0
\A3 \C0 \G0 \J0 \K5 \N3 \T00 \V2 \X0 %A013 %C1-J1 "H3"O016
S00:000 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002 S07:060 S08:002
S09:006 S10:014 S11:095 S12:050 S14:170 S16:000 S18:000 S21:048 S22:118
S23:021 S25:005 S26:001 S27:064 S30:010 S37:000 S90:000 S108:002 S109:062

Stored Profile 1:

B1 E1 L2 M1 N1 P Q0 V1 X4 Y0 &C1 &D2 &G0 &J0 &P0 &Q0 &R0 &S0 &X0
\A3 \C0 \G0 \J0 \K5 \N3 \T00 \V2 \X0 %A013 %C1-J1 "H3"O016
S00:000 S06:002 S07:060 S08:002 S09:006 S10:014 S11:095 S12:050 S14:170
S16:000 S18:000 S21:048 S22:118 S23:021 S25:005 S26:001 S27:064 S30:010
S37:000 S90:000 S108:002 S109:062

Telephone Numbers:
&Z0 12345
&Z1 T4444444
&Z2 T12345
&Z3 T 1 (123) 456-7890

&Wn Store the Current Configuration to Nonvolatile RAM

&W0	Writes the current active configuration to profile 0 in nonvolatile RAM. (default)
&W1	Writes the current active configuration to profile 1 in nonvolatile RAM.

&Yn Select the Default Profile

&Y0	Uses profile 0 on power-up. (default)
&Y1	Uses profile 1 on power-up.

&Zn Store Telephone Numbers (n=0 to3)

&Zn Stores one of four dial strings (including a telephone number) of up to 38 digits in nonvolatile RAM.

For example: to store the telephone number 002852117 to RAM location 1, issue the following command:

Command: AT&Z1=002852117 <CR>

2.2b Commands Preceded by\

\An Maximum MNP Block Size

Sets maximum block size for MNP connections. Use this command to transmit smaller blocks of data in a reliable link connection,

\A0	Sets maximum block size to 64 characters.
\A1	Sets maximum block size to 128 characters.
\A2	Sets maximum block size to 192 characters.
\A3	Sets maximum block size to 256 characters (default)

\Bn Transmit Break

This command causes the modem to send a break (Attention signal), for a duration specified by 'n', to the remote modem. When n = 0, the default break length is used.

n= 0-9	Break length in 100 msec.

\Cn Set Auto-reliable Buffer (requires a license from Microcom ®

In auto-reliable mode (\N3), this command determines the fallback method and enables data buffering. The settings for this command are used by the modem during the V.42 detection phase.

\C0	Does not buffer data. (default)
\C1	Buffers data for four seconds until 200 characters have been buffered or SYN character is detected, then switches to reliable mode. If the buffer fills, data is passed to the serial port.
\C2	Does not buffer data. Switches to normal mode upon receipt of auto-reliable fallback character and passes it to serial port. This feature is used to allow non-v.42 modems to connect immediately to a V.42 modem without data loss.

\Gn Modem to Modem Flow Control (XON/XOFF)

\G0	Disable flow control. (default)
\G1	Enable flow control.

\Jn Enable/Disable DTE Auto Rate Adjustment

\J0	Disable adjustment of DTE speed to match line speed. (default)
\J1	Enable adjustment of DTE speed to match line speed.

\Kn Break Control

Defines what action the modem takes when a break (Attention signal) is sent or received, as described below.

In Connect State, if reliable mode then transmit break to remote:

n = 0,2,4	Enter command state, but do not send a break.

n = 1	Destructive/expedited,
n = 3	Non-destructive/expedited.
n = 5	Non-destructivelnonexpedited.

In Command State, if reliable mode then transmit break to remote:

n = 0,1	Destructive/expedited.
n = 2,3	Non-destructive/expedited.
n = 4,5	Non-destructive/non-expedited.

In Connect State, if direct mode then receive break at serial port:

n = 0,2,4	Immediately send break and enter command state.
n = 1,3,5	Immediately send break through.

In Connect State, receive break at modem port, send to serial port:

n = 0,1	Destructive/expedited.
n = 2,3	Non-destructive/expedited.
n = 4,5	Non-destructive/non-expedited.

Default: 5

\Nn Set Operating Mode

Determines the type of connection attempted by the modem.

\N0	Normal Mode - No data compression or error correction, but uses speed buffering.
\N1	Direct Mode - No data compression, error correction, or speed buffering.
\N2	MNP Reliable Mode - The modem attempts to negotiate an MNP error-correction 'reliable' link, hanging up if it fails.

\N3	V.42 Auto-reliable Mode * - If V.42 detection is enabled (-Jn), a LAPM or MNP link can be detected and negotiated, otherwise only LAPM will be attempted. If configured for -J0 and a protocol connection is not made, the modem will hang up. If configured for -J1 and a protocol connection is not made, the modem will fall back to speed buffering mode. (default)
\N4	V.42 Reliable - The modem attempts to negotiate LAPM error correction, hanging up if it fails.

NOTE: 300 bps does not support synchronous operation. The mode will automatically fall back to MNP asynchronous operation.

\O Originate Reliable Link

in normal mode (\N0), the modem will attempt to originate an MNP link, regardless of whether the modem originated or answered the telephone call (physical connection). The remote modem must answer the MNP link request for the link to be established (refer to the \U command).

\Qn Set Serial Port Flow Control

This command specifies the DTE-to-modem flow control. Software flow control uses the XOFF (13 hex) and XON (11 hex) characters to stop and start data transmission, respectively, both to and from the DTE. Unidirectional hardware flow control uses the CTS control line to stop/start data from the DTE only, while bidirectional hardware flow control also uses the RTS control to stop/start data from the modem.

\Q0	Disables flow control.
\Q1	XON/XOFF software flow control.
\Q2	Unidirectional hardware flow control.
\Q3	Bidirectional hardware flow controll. (default)

\Tn Set Inactivity Timer

During a normal or reliable connection, if no data is sent or received within the inactivity time period, the link will be disconnected. The default of zero disables this feature.

n=0-90	Lenth in minutes.
\T0	Disables inactivity timer. (default)

\U Accept Auto-reliable Link

in normal mode (\N0), the modem attempts to answer an MNP link request regardless of whether the modem originated or answered the telephone call (physical connection). The remote modem must originate the MNP link request for the link to be established (refer to the '\O' command).

\Vn Modify Result Code Form

This command specifies which modem response codes are supported.

\V0	Enables codes defined by ATV command. (default)

\V1	Enables modified MN P codes.
\V2	Enables extended V.42 codes.

\Xn Set XON/XOFF Passthrough

If software flow control is enabled (\Ql), this command defines whether the XON (11 hex) and XOFF (13 hex) characters received from the DTE are sent to the remote modem. In addition, if the modem port flow control is enabled (\G1) in normal mode, the command specifies whether the XON and XOFF characters received from remote modem are sent to the DTE. In both cases, flow control operation is not affected.

\X0	Processes flow control characters. (default)
\X1	Processes flow control characters and passes them through to the local or remote so they can process the characters.

\Y Switch to Reliable Mode

in normal mode (\N0), the modem attempts to originate or answer an MNP link request, depending on whether the modem originated or answered the physical connection, respectively. The remote modem must attempt to answer/originate the MNP link for the link to be established.

\Z Switch to Normal Mode

During an MNP link, the modem will disconnect the link (exit error correction/ data compression) and change to narmal mode, without disconnecting the modem-to-modem connection.

2.2.c Commands Preceded by %

%An Set Auto-reliable Fallback Character

In auto-reliable mode (\N3), with auto-reliable fallback character enabled (\C2), receipt of the fallback character from the line during the V.42 detection phase will cause to modem to switch to normal mode. This allows a remote user with a non-V.42 modem to connect immediately with a V.42 modem, A space or carriage return is usually chosen for the fallback character.

n=0-127 (ASCII character)

%Cn MNP 5 Data Compression Control

This command controls whether the data sent during the MNP frames is compressed using MNP Class 5 compression standard. MNP 5 data compression can improve throughput by as much as 150%

%C0	No compression.
%C1	MNP Class 5 compression. (default)

%En Auto-retrain Control (V.22 bis and V.32 bis only)

This command controls whether the modem will automatically initiate a modem retrain whenever the Received Data signal quality falls below a threshold that may affect data reliability. The value for 'n' is stored in the NVRAM, but it is not displayed by the **'AT&Vn'** command.

%E0	Disabled.
%E1	Enabled. (default)

%Gn Auto Fallforward/fallback Enable (V.32 bis only)

This command selects whether the modem will automatically initiate a change to a higher speed or lower speed depending on received signal quality (i.e. Rate Negotiation). The modem always responds to any rate change initiated by the remote modem.

%G0	Disabled. (default)
%G1	Enabled.

%Q Line Signal Quality

This command returns the higher order byte of the EQM value, This information indicates the quality of the telephone line signal. Note that this value will be different for different DAAs.

Range:	0-255
0-7	No Retrain

8-255	Modem performs a Retrain. (i.e., if configured for %E1)

2.2.d Commands Preceded by - and “

-Cn Generate Data Modem Calling Tone

This command allows the DTE to select whether the modem will send 1300 Hz calling tone when originating a Data Modem connection.

-C0	Calling tone disabled. (default)
-C1	Calling tone enabled.

-Jn Set V.42 Detect Phase

In V.42 modes (\N3, \N4), this command specifies whether the modem will detect V.42, MNP, or no error-correcting protocols from the remote modem and change to the appropriate mode. Otherwise, only LAPM will be attempted.

-J0	Disables the V.42 detect phase.
-J1	Enables the V.42 detect phase. (default)

“Hn V.42 bis Compression Control

This command specifies whether the data in the LAPM frames are compressed using the V.42 bis data compression, which can improve throughput by as much as 400%. Compression can be negotiated to operate in only one direction, or in both directions.

“H0	Disables V.42 bis.
“H1	Enables V.42 bis only when transmitting data.
“H2	Enables V.42 bis only when receiving data.
“H3	Enables V.42 bis for both transmitting and receiving data. (default)

“On V.42 bis String Length

This command specifies the maximum number of characters that can be compressed into one V.42 bis code word. The default value of 16 optimizes throughput for most file types.

n=6-250=Number of characters

2.3 Dial Modifers

This section describes all of the dial modifiers which are used in dial strings.

@ Wait for Quiet Answer

Cause the modem to wait for specified amount of time (S-register S7) followed by 5 seconds of silence before processing the next dial modifier.

,

Pause

",", placed anywhere in the dial string, tells the modem to pause for the number of seconds specified by S-register S8 before processing the rest of the dial string.

!

Initiate a Hookflash

"!", placed anywhere in the dial string, tells the modem to initiate a hookflash, which means to hang up for 0.75 seconds and then go off-hook again before processing the rest of the dial string. This modifier allows access to PBX features like call transferring.

-( )

Ignored by Modem

These four characters are ignored by the modem, but space may be included in the dial string for separating area codes and numbers.

Return to Idle State

Causes the modem to enter on-line command mode without initiating a data modem handshake (used for phone directory auto-dialers).

P Pulse Dialing

P, placed ahead of a number, tells the modem to dial a number using pulse dialing.

R Reverse Originate Mode to Answer Mode

R, which can only be placed at the end of the dial string, tells the modem to change from the originating mode to the answer mode once it dials all the digits before the R. This modifier is used to call an originate-only modem,

S Dial a Stored Number

S is used to dial one of four numbers stored in nonvolatile memory. For example, instead of entering a dial string, you can use this command:

Command: ATDTS=1<CR>

T Tone Dialing

T, placed ahead of a number, tells the modem to dial a number using touchtone dialing,

W Wait for Dialtone

Causes the modem to look for dial tone for a specified amount of time. If dial tone or the amount of time specified by the S-register S6 times-out, the modem will then process the next command in the dial string. If a busy signal is detected, the modem will respond back to the DTE with a busy response code, and then go into off-line command mode.

2.4 Time Independent Escape Sequence (TIES)

The Time Independent Escape Sequence (TIES) has been developed by a group of modem manufacturers as an alternative to the Hayes Escape Sequence. TIES has been designed to work with existing communication software written for the Hayes Escape Sequence.

The escape sequence is sent by the host (DTE) to return the modem to command state while in the on-line data state (connected to another modem) or diagnostic mode (&Tn commands).

The DTE implements the escape sequence by sending the escape character three times, followed by a valid 'AT' command and the contents of S3 (typically a <CR>). Upon detecting the three consecutive escape characters, the modem changes to a TIES command mode, and starts an internal Escape Prompt Delay timer (EPD) - with the time limit as defined by S12.

If the EPD timer times out, the modem sends an 'OK' message to the DTE

and then waits indefinitely for an incoming valid 'AT' command string from the DTE.

If the next character received by the modem is not an 'A' or 'a', then the modem returns to data mode and sends a 'CONNECT message back to the DTE.

If the modem receives an 'A' or 'a', the modem disables the EPD timer (if it has not time out) and sends the character to the remote modem. The modem then stores any received data from the DTE into the modem internal command buffer and sends the data to the remote modem. Upon detecting a <CR> or receiving Up to 39 data characters, the modem then determines if a valid 'AT' command has been received and then processes the valid commands. If a non-'AT' command string or an invalid command string has been received then the modem will remain in data mode. If a valid 'AT' command has been received, then the modem changes to command mode and sends an 'OK message. After sending the 'OK message, the modem will echo back any received data from the DTE while in command mode.

While in TIES command mode, the modem ignores certain characters that may cause the modem to incorrectly decide that an incoming 'AT' string is invalid. The ignore character are <LF>, <space>, and <CR> (<CR> is ignored only when S3 is not equal to <CR>). Not all 'AT' commands are supported during TIES command mode. The following is a list of supported commands:

E, H, M, O, Q, S, V, X, Z, and ampersand'&' commands

The escape character is determined by the value stored in S-register S2, and is typically a + character. An example of the TIES Escape Sequence is

provided below.

Format: <char1> <char2> <char3> <AT command> <contents of S3>
char1=char2=char3=escape character (S2)

e.g., DTE: +++AT<CR>

DCE: OK

NOTE: TIES requires that the three-character escape sequence be contiguous and not repeated. The character immediately preceding the first character of the three-character sequence cannot be the same as the escape character. Therefore, '+++AT<CR>' is valid, but '++++ AT<CR>' is not.

2.5 Result Codes

Basic Response Codes (\V0)

Numeric Code	Verbose Code
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR
5	CONNECT 1200
6	NO DIAL TONE
7	BUSY

Numeric Code	Verbose Code
8	NO ANSWER
10	CONNECT 2400
11	CONNECT 4800
12	CONNECT 7200
14	CONNECT 9600
16	CONNECT 12000
17	CONNECT 14432

Modified Response Codes (\V1)

Numeric Code	Verbose Code
22	CONNECT 300/REL
24	CONNECT 1200/REL
25	CONNECT 2400/REL
26	CONNECT 4800/REL
27	CONNECT 7200/REL
28	CONNECT 9600/REL
29	CONNECT 12000/REL
30	CONNECT 14400/REL

V.42 Extended Response Codes (\V2)

Numeric Code	Verbose Code
32	CONNECT 300/REL-MNP
34	CONNECT 1200/REL-MNP
35	CONNECT 2400/REL-MNP

Numeric Code	Verbose Code
36	CONNECT 4800/REL-MNP
37	CONNECT 7200/REL-MNP
38	CONNECT 9600/REL-MNP
39	CONNECT 12000/REL-MNP
40	CONNECT 14400/REL-MNP
42	CONNECT 300/REL-MNP 5
44	CONNECT 1200/REL-MNP 5
45	CONNECT 2400/REL-MNP 5
46	CONNECT 4800/REL-MNP 5
47	CONNECT 7200/REL-MNP 5
48	CONNECT 9600/REL-MNP 5
49	CONNECT 12000/REL-MNP 5
50	CONNECT 14400/REL-MNP 5
54	CONNECT 1200/REL-LAPM
55	CONNECT 2400/REL-LAPM
56	CONNECT 4800/REL-LAPM
57	CONNECT 7200/REL-LAPM
58	CONNECT 9600/REL-LAPM
59	CONNECT 12000/REL-LAPM
60	CONNECT 14400/REL-LAPM
64	CONNECT 1200/REL-LAPM V.42 BIS
65	CONNECT 2400/REL-LAPM V.42 BIS
66	CONNECT 4600/REL-LAPM V.42 BIS
67	CONNECT 7200/REL-LAPM V.42 BIS
68	CONNECT 9600/REL-LAPM V.42 BIS
69	CONNECT 12000/REL-LAPM V.42 BIS
70	CONNECT 14400/REL-LAPM V.42 BIS

3 - S REGISTER REFERENCE

Your modem has status registers. These registers are memory locations inside your modem which control your modem's operation. You usually do not have to worry about setting any register because the default values work for most applications.

The S registers are summarized in Fig. 3-1, along with their default values. Registers denoted with an "*" may be stored in one of the two user profiles by entering the &Wn command, One of these profiles may be loaded at any time by using the Zn command.

The factory default values are stored in ROM and are loaded into the active configuration at power-up or by the Zn command. In addition, the designated default profile is subsequently loaded, and may change some of the factory default values. The designated default profile can be changed by entering the &Yn command. where 'n' is one of the two possible user profiles. The factory defaults can be loaded at any time by entering the &F command.

3.1 Register Summary

The following chart summarizes your modem's registers:

S-Registers Command		Default	Type	Function
S0	*	0	R/W	No. of Rings to auto-answer on
S1		0	R/W	Ring count
S2	*	43	R/W	Escape character
S3		13	R/W	Carriage return character
S4		10	RAN	Line feed character
S5		8	R/VV	Backspace character
S6	*	2	R/W	Wait before dialing
S7	*	60	R/W	Wait for carrier
S8	*	2	R/W	Pause time for dial modifier
S9	*	6	R/W	Carrier recovery time
S10	*	14	R/W	Lost carrier hang up delay
S11	*	95	R/W	DTMF dialing speed
S12	*	50	R/W	Guard time
S13		none	-	Reserved
S14	*	none	R	Bit-mapped options
S15		none	-	Reserved
S16	*	none	R	Modem test options
S17		none	-	Reserved
S18	*	0	R/W	Modem test timer
S19		none	-	Reserved
S20		none	-	Reserved

S21	*	none	R	Bit-mapped options
S22	*	none	R	Bit-mapped options
S23	*	none	R	Bit-mapped options
S24		none		Reserved
S25	*	5	R/W	Detect DTR change
S26	*	1	R/W	RTS-to-CTS delay interval
S27	*	none	R	Bit-mapped options
S30	*	10	R/W	Sleep mode timer
S37	*	0	R/W	Maximum line speed attempted
S90	*	0	R/W	Disconnect Inactivity timer
S108	*	1	R/W	Retrain signal quality selector
S109	*	62	R/W	Line speeds permitted

NOTE: (*) Value Saved in NVRAM (R) Read-only register
(-) Reserved register (R/W) Read/write register

3.2 Glossary of the S Registers

S0 Number of Rings to Auto-Answer On

Assigning S0 a value from 1 to 255 configures the modem for auto-answer mode, The modem will automatically go off-hook and initiate a data-mode-answer mode handshake after detecting the specified number of rings,

Range:	0-255 rings
n = 0	Auto-answer mode disabled.
n = 1-255	Auto-answer mode enabled.

S1 Ring Count

Reports the number of ring signals detected by the modem. This register is cleared to zero if no ring signals are detected within an eight-second time interval.

Range: 0-255 rings
Default: 0 rings

S2 Escape Character

S2 specifies ASCII value for the TIES escape character. The factory

defaut is '+' or ASCII decimal 43. The escape character may range between 0-127. Any value over 127 will disable the escape sequence.

Range: 0-127
Default: 43 ('+')

S3 Carriage Return Character

S3 specifies the 'AT' command string terminator and modem response code terminator. The factory default is a <CR> or carriage return (ASCII decimal 13).

Range: 0-127
Default: 13 (carriage return)

S4 Line Feed Character

S4 specifies the line feed character. The line feed character is used for verbose (text) modem result codes.

Range: 0-127
Default: 10 (line feed)

S5 Backspace Character

S5 specifies the backspace character that is used to delete the last-entered character. After receiving a backspace character, the modem sends three characters to the DTE: a backspace character, a space character, and then another backspace character.

Range: 0-32, 127
Default: 8 (BS)

S6 Wait Before Blind Dialing

S6 specifies the amount of time after the modem goes off-hook before the modem starts dialing the first telephone number. The modem waits for at least 2 seconds, even if S6 is set for a value less than 2, before dialing the first number. S6 is only used for result code type commands X0, X1, X3 (i.e., blind dialing result code types). The 'W' (wait for dial tone) dial modifier causes the modem to ignore the contents of S6. Result code types X2 and X4 enable dial-tone detection, but never use S6.

Range: 2-255 seconds
Default: 2 seconds

S7 Wait for Carrier/Dial tone

S7 specifies the amount of time that the modem waits to detect the

remote modem carrier after dialing the telephone number. If the remote modem carrier is not detected within the S7 time limit, the modem will hang-up and send a NO CARRIER response code to the DTE. If the remote modem carrier is detected, the modem goes into on-line data mode and sends a CONNECT message to the DTE.

S7 also specifies the time duration for the 'W' (wait for dial tone) dial modifier.

Range: 1-255 seconds
Default: 60 seconds

S8 Pause Time for Dial Modifier

S8 specifies the amount of time that the modem will pause during the dialing process each time the ',' dial modifier is detected in the dialing string,

Range: 0-255 seconds
Default: 2 seconds

S9 Carrier Detect Response Time

S9 specifies how long the remote modem carrier must be present on the telephone line before the modem will detect it and turns on DCD, The greater the time duration, the less likely that a false

carrier detection will occur due to noise on the telephone line.

Range: 1-255 (1/10 of a second)
Default: 6 (equals 0.6 seconds)

S10 Lost Carrier Hang Up Delay

S10 specifies amount of time the modem waits before hanging up after the loss of the remote modem carrier. This delay allows for the temporary loss of the remote modem carrier without causing the local modem to hang up. When set to 255, the modem will not disconnect upon loss of the remote modem carrier.

Range: 1-255 (1/10 of a second)
Default: 14 (equals 0.6 seconds)

S11 DTMF(Touch-tone) Dialing Speed

S11 determines the duration and spacing of tones for Dual Tone Multifrequency (DTMF) dialing. This value has no effect on pulse dialing.

Range: 50-255 milliseconds
Default: 95 milliseconds

S12 Guard Time

S12 is used to specify guard and detect times used for the TIES Escape Sequences.

For the TIES Escape Sequence, S12 specifies the maximum time limit after receiving the three escape characters and no other characters before sending an OK message to the DTE.

Range: 0-255 (1/50 of a second)
Default: 50 (equals 1 second)

S13 Reserved

S14 Bit Mapped Options

Bit	Value	Description
Bit 0		Reserved
Bit 1	0	E0 is selected.
	1	El is selected. (default)
Bit 2	0	Q0 is selected. (default)
	1	Q1 is selected.
Bit 3	0	V0 is selected.
	1	V1 is selected. (default)
Bit 4		Reserved
Bit 5	0	T (tone) dial is selected.
	1	P (pulse) dial is selected. (default)
Bit 6		Reserved

Bit	Value	Description
Bit 7	0	Answer.
	1	Originate. (default)

S15 Reserved

S16 Modem Test Options

Bit	Value	Description
Bit 0	0	Local analog loopback disabled. (default)
	1	Local analog loopback enabled. (&T1)
Bit 1	0	Reserved.
Bit 2	0	Local digital loopback disabled. (default)
	1	Local digital loopback enabled. (&T3)
Bit 3	0	Remote digital loopback off. (default)
	1	Remote digital loopback in progress. (&T6)
Bit 4	0	RDL not active. (default)
	1	RDL request from distant end is in service.
Bit 5	0	Remote digital loopback with self-test disabled. (default)
	1	Remote digital loopback with self-test enabled. (&T7)
Bit 6	0	Analog loopback with self-test disabled. (default)
	1	Analog loopback with self-test enabled. (&T8)
Bit 7	0	Reserved.

S17 Reserved

S18 Modem Test Timer

S18 specifies the amount of time that the modem will conduct one of the loopback tests (&Tn). After timing out, the modem returns back to command mode. Setting S18 to zero disables the modem test timer; the loopback test must be terminated by issuing the appropriate escape sequence followed by an 'AT&T0' or 'ATH'.

Range: 0-255 seconds
Default: 0 second

S19 Reserved

S20 Reserved

S21 Bit Mapped Options

Bit	Value	Description
Bit 0	0	&J0 is selected. (default)
	1	&J1 is selected.
Bit 1		Reserved.
Bit 2	0	&R0 is selected. (default)
	1	&R1 is selected.

Bit	Value	
Bits 4-3	00	&D0 is selected,
	01	&D1 is selected.
	10	&D2 is selected. (default)
	11	&D3 is selected.
Bit 5	0	&C0 is selected.
	1	&C1 is selected. (default)
Bit 6	0	&S0 is selected. (default)
	1	&S1 is selected.
Bit 7	0	Y0 is selected. (default)
	1	Y1 is selected,

S22 Bit Mapped Options

Bit	Value	Description
Bits 1-0	00	Reserved.
	01	L1 is selected,
	10	L2 is selected. (default)
	11	L3 is selected.
Bits 3-2	00	M0 is selected.
	01	M1 is selected. (default)
	10	M2 is selected.
	11	M3 is selected.
Bits 6-4	000	X0 is selected.
	001	Reserved.
	010	Reserved.
	011	Reserved.
	100	X1 is selected.
	101	X2 is selected.
	110	X3 is selected.
	111	X4 is selected. (default)

Bit	Value	Description
Bit 7	0	&P0 is selected. (default)
	1	&P1 is selected.

S23 Bit Mapped Options

Bit	Value	Description
Bit 0	0	&T5 is selected.
	1	&T4 is selected. (default)
Bit 3,2,1	000	0-300 bps communications rate.
	001	1200 bps.
	010	2400 bps.
	011	4800 bps.
	100	7200 bps.
	101	9600 bps.
	110	19.2 Kbps.
	111	38.4 kbps.
Bit 5,4	00	Even parity. (default)
	01	Space parity/no parity.
	10	Odd parity,
	11	Mark.
Bit 7,6	00	&G0 is selected. (default)
	01	&G1 is selected.
	10	&G2 is selected,
	11	Reserved.

S24 Reserved

S25 Detect DTR Change

S25 defines the minimum amount of time that DTR has to remain off (i.e., on-to-off-to-on transitions) before the modem will perform the function specified by '& Dn'command. A change in DTR that persists for a shorter time than the valued specified in S25 is ignored by the modem (see '&Dn' command).

Range: 0-255 (1/100 of a second)
Default: 5

S26 RTS to CTS Delay Interval

S26 is only used for synchronous operation. This register, when the modem is configured for &R0, specifies the time delay between an off-to-on transition on RTS and turning CTS on.

Range: 0-255 (1/100 of a second)
Default: 1 (is equal to second)

S27 Bit Mapped Options

Bit	Value	Description
Bit 3,1,0	000	&Q0 is selected. (default)
	001	&Q1 is selected.
	010	&Q2 is selected,
	011	&Q3 is selected.

Bit	Value	Description
Bit 3,1,0	100	&Q4 is selected.
	101	Not used.
	110	Not used.
	111	Not used.
Bit 2	0	&L0 is selected. (default)
	1	&L1 is selected.
Bit 5,4	00	&X0 is selected. (default)
	01	&X1 is selected,
	10	&X2 is selected.
	11	Reserved.
Bit 6	0	B0 is selected.
	1	B1 is selected. (default)
Bit 7		Reserved.

S30 Sleep Mode Timer

S30 determines when the modem enters sleep or powerdown mode. When enabled (S30 ≠ 0), the DSµP will enter sleep mode whenever the modem has been inactive for a user-programmable time delay (S30). The modem is considered to be in an inactive state when:

1) No internal processing is being performed;
2) There is no activity between the host and the modem within a specified time period;
3) The modem is off-line.

The modem exits sleep modem whenever the host reads or writes to the modem, or a ring signal is detected.

Sleep mode is disabled by setting S30 to a '0'.

Range: 0-90 seconds

S37 Maximum Line Speed Attempted

This S-register selects the maximum line speed allowable (i.e., the modem will attempt to connect at this speed or fallback to a lower speed). Note that S37 has no effect during V.32 bis retraining/rate negotiation,

Range: n=0-11

n=0	**DTE rate**
n=1	**Reserved**
n=2	**Reserved**
n=3	**300**
n=4	**Reserved**
n=5	**1200**
n=6	**2400**
n=7	**4800**
n=8	**7200**
n=9	**9600**
n=10	**12000**
n=11	**14400**

S90 Disconnect Inactivity Timer

This S-register sets the length of time, in minutes, that the modem will stay on-line /off-hook before disconnecting when no data is trans mitted or received. In data and fax modes, any data transmitted or received between the DTE-DCE interface will reset the timer. In all other modes except Telephone-emulation mode, any data transmitted will reset the timer. In Telephone-emulation mode,S90 is ignored (i. e., the modem will not automatically hangup the line after a given time delay).

Range: n= 0-255 minutes

n=0 Disabled

S108 Retrain Signal Quality Selector

This S-register selects when the modem should perform a retrain.

Range: n= 0-3

n=0	Never retrain
n=1	Low Quality - retrain after a large number of data errors
n=2	Medium Quality - retrain after a number of data errors
n=3	High Quality - retrain after a few data errors

Default: V.32 n=1
V.32 bis n=2

S109 Line Speeds Permitted

This bit mapped S-register selects all permitted line speeds. If the speed bit is set to a '1', then the modern is permitted to connect at the specified speed. If the speed bit is set to a '0', then the modem will never connect at the specified speed.

Bit 0 **Reserved**
Bit 1 **4800**
Bit 2 **7200**
Bit 3 **9600**
Bit 4 **12000**
Bit 5 **14400**
Bit 6-7 Reserved

Default: V.32 S109=10 Bit 2, 4, and 5 not supported.
V.32 bis S109=62

4 - TESTING

The modem provides five testing features to identify fault location when transmission quality is not good: local digital loopback, local analog loop back, local analog loopback with self-test, remote digital loopback, and remote digital loopback with self-test. These tests are initiated with the &Tn command described in Chapter 2.

4.1 Local Analog Loopback

The local analog loopback test checks the integrity of the local computer or terminal and the local modem. During the test. the local modem internally loops data sent from the local computer or terminal back to the same computer or terminal as shown in Figure 4-1. During the test, data is not transmitted to the remote modem.

If characters are looped correctly during this test, both the modem and the local computer or terminal are functioning correctly, If incorrect characters appear on the screen, either the local computer or terminal or the local modem is in error.

To perform a local analog loopback, put the local modem in the command state. If it is on-line, issue the escape command + + +, to return to the command state.

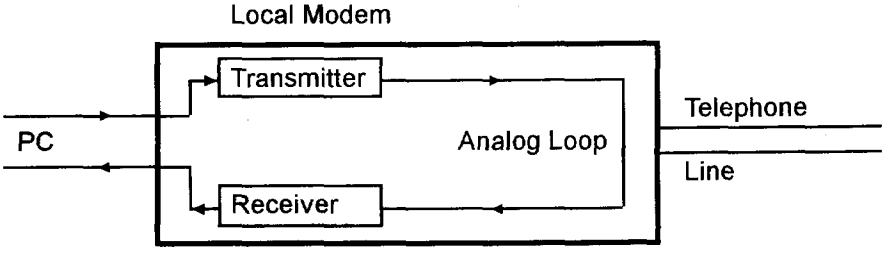

Fig. 4-1 Data Path for Local Analog Loopback

Example 1 - Test timer disabled

Command:	**AT/N1 <CR>** **ATS18=0&Tl <CR>**
Result:	**cursor shifts down one line**
Test message:	**THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 1234567890**
Escape:	**+ + +** **(return to the on-line command state)**
Result code:	**OK**
Command:	**AT&T0 <CR> (end the test)**
Result code:	**OK**

Here, the test timer is disabled and the modem sets up an internal analog loop as shown in Figure 4-1. When the loopback is established, the modem goes on-line and the test message (any character you type) is looped back on the screen for verification. Finally, +++ returns the modem to the command state and &T0 ends the test and breaks the internal analog loop.

The following command sequence is the same as the previous one except that the test timer is set to 60 seconds. At the end of the test time, the timer expires, the test ends, and the test result is reported.

Example 2 - Test timer enabled

Command:	**AT/N1<CR>** **ATS18=60&T1 <CR>**
Result:	**cursor shifts down one line**
Test message:	**THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 1234567890**
Escape:	**OK**

4.2 Local Analog Loopback with Self-Test

The local analog loopback with self-test checks the integrity of the local modem. In this test, an internally generated data pattern of alternate binary ones and zeros (reversals) at the selected bit rate is looped through the internal analog loop inside the local modem to an internal error counter as shown in Figure 4-2. An error count of 255 indicates that 255 or more errors were detected.

Example - The test timer is disabled and 12 errors are found during the test

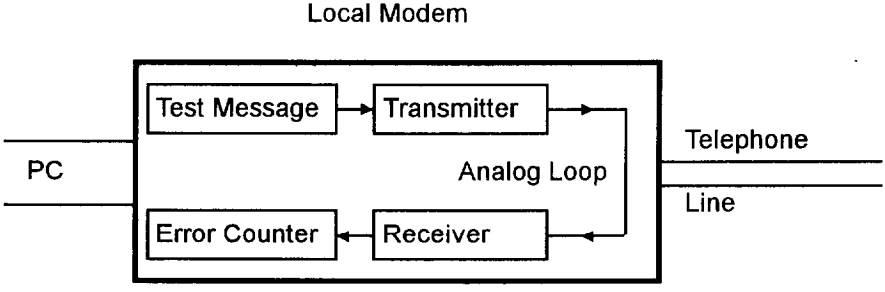

Fig. 4-2 Local Analog Loopback with Self-test

Command: **AT\N1<CR>**
ATS18=0&T8<CR>

Result: **cursor shifts down one line (test starts)**

Command:	AT&T0< CR> (ends the test)
Test result:	012 (12 errors were found during the test)
Result code:	OK

4.3 Remote Digital Loopback

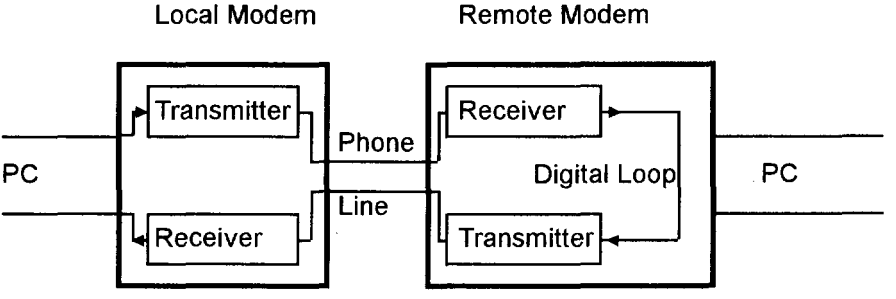

Fig. 4-3 Data Path for Remote Digital Loopback

The remote digital loopback test cheeks the integrity of the local computer or terminal, the local modem, the telephone line, and the remote modem, During the test message is sent from the local computer through the local modem to the remote modem and looped through the remote digital loop inside the remote modem back to an internal error counter as shown in Figure 4-3.

During this test, data is not transmitted to the remote computer or terminal. If characters are looped correctly, the local computer or terminal, the local modem,

the telephone line and the remote modem are all operating correctly.

To start a remote digital loopback, first make sure the modem is on-line with a remote modem.

Below, in the second command line, the timer is inactive, in the third command line, the test timer is activated for 60 seconds.

Command: **AT\N1<CR>**
ATS18=0&T6<CR>
ATS18=60&T6<CR>

4.4 Remote Digital Loopback with Self-Test

The remote digital loopback with self-test checks the integrity of the local modem, telephone line, and the remote modem. In this test the modem activates an internal test pattern generator. A test data stream is sent over the telephone line to the remote modem and looped through a remote digital loop to an internal error counter in the local modem as shown in Figure 4-4.

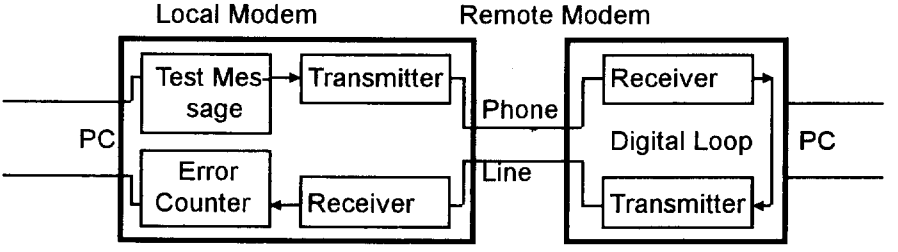

Fig. 4-4 Remote Digital Loopback with Self-test

To perform the remote digital loopback with self-test, first make sure that the modem is on-line to the remote modem. The modem can be either in the originating mode or in the answer mode.

Example - The test timer is set and the test is performed with no errors

Escape command	**+++** **(return the modem to the on-line command state)**
Result code:	**OK**
Command:	**AT\N1 <CR>** **ATS18=60&T3<CR>**
Result:	**cursor shifts down one line** **(test starts)**
Test result:	**000** **(timer expires and no errors were found)**
Result code:	**OK**

4.5 Local Digital Loopback

Local digital loopback checks the integrity of the remote modem and the phone line if the remote user suspects either to be the cause of transmission errors.

During this test the modem loops data internally sent from the remote modem back to the remote modem as shown in Figure 4-5, During the test, data is not received by the local personal computer. Local digital loopback is useful when a remote modem is unable to request a remote digital loopback.

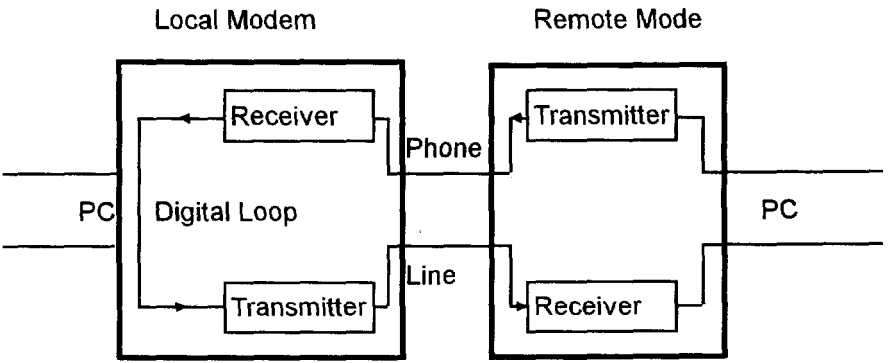

Fig. 4-5 Data Path for Local Digital Loopback

To start a local logical loopback first make sure that the modem is on-line with a remote modem. The modem can be in either the originating or answer modem.

Example - To implement a local digital loopback test

Escape: **+++**

Result Code: OK

Command: **AT\N1 <CR>**
ATS18= 0 &T3<CR>

Result Code: OK

This command sequence returns the modem to the command state but does not break the established connection. It then disables the test timer and sets up an internal digital loop inside the modem. End the test when you confirm that the remote user has already finished by issuing:

Command: **AT&T0<CR>**

Result Code: OK

4.6 Grant or Deny RDL Request from Remote Modem

The modem can grant a request from the remote modem for a remote digital loopback **test** with the &T4 command (default). Once the modem grants the request, it sets up an internal digital loop as in Figure 4-5. When the remote modem terminates the remote digital loopback test by sending a termination sequence. The modem breaks the external digital loop.

The modem can deny the request for a remote digital loopback test with the &T5 command. To set **&T5** as the default. issue:

Command: **AT\N1 <CR>**
AT&T5&W<CR>

Result Code: OK

5 - TROUBLESHOOTING GUIDE

This chapter describes common problems in the installation, configuration and regular usage of your Fax/Data Modem. To test the Fax/Data Modem, a communication software package is needed and the package must include a mode that allows you to operate your Fax/Data Modem by directly issuing internal commands to the modem.

Follow the procedures in the following sections to resolve these common problems:

No **Response From Your Modem**

1. If you are using the internal add-on card modems, make sure that the COM port address you have set your modem to corresponds to the appropriate selection in the communications software which you are using.

2. Issue the **ATZ** command to reset your modem. The returned result code should be “0” or “OK’ depending on what communications program you are using. Your modem is OK if you get one of these responses. If there is no response after issuing the ATZ<CR>, continue to the next step.

3. Check if there are any other interface cards in your computer that use the same COM port address as your modem. If so, you must set your modem to another COM port address. (Keep in mind that on most systems, only two COM ports are available. One of them must be used as either 1 or 3, while the other must be used as 2 or 4.) For example, if a mouse is set to COM 1,

your modem should be set to COM2 or COM4. Continue to the next step if the COM port address is OK.

4. Issue the command: AT&F&W <CR>, if a "0" or "OK result code is displayed on the screen, your modem is OK. Otherwise, contact your dealer for assistance.

Your Modem Does Not Dial Out

Make sure that your modem responds normally as described in section 4.1. If you can communicate through the keyboard, check whether the modem is properly connected to the phone line.

Your Modem Does Not Connect After It Has Dialed a Phone Number

The problem may have several causes. The phone line may be too noisy or the telephone cord may be poor. Try the line with a regular phone. Also the remote modem may not recognize your modem's baud rate.

Your Can't Transmit After You Have Connected to the Remote Modem

In this case, check the communication parameters of the remote modem, then configure your software to the same number of data bits, stop bit, and parity.

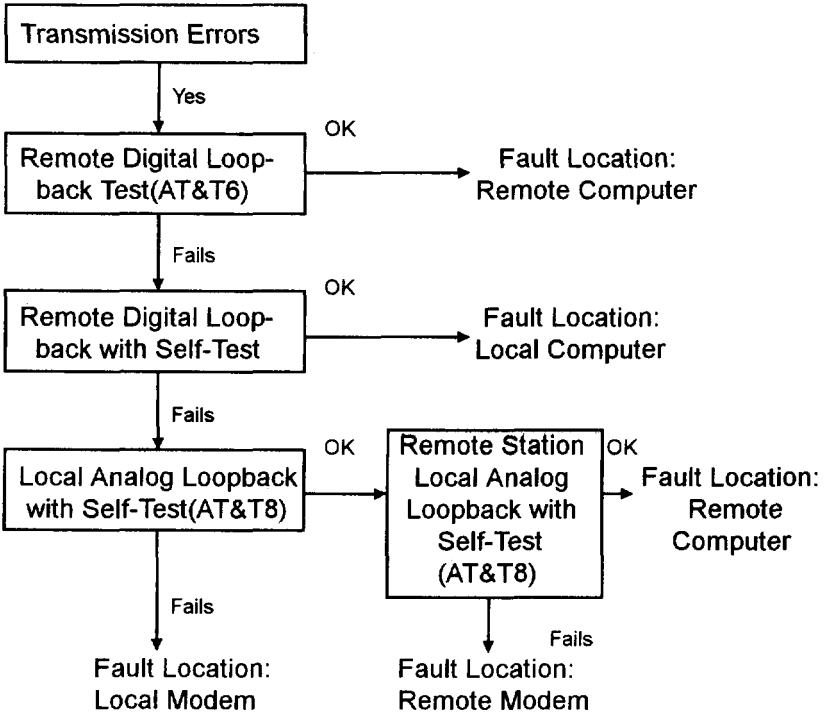

Fig. 5-1 Troubleshooting Flowchart

Finding the Source of Transmission Errors

A failure in modem communication is usually characterized by unacceptably high error rates or a total inability to communicate; it may be the fault of the local computer or terminal, the local modem, the telephone line, the remote modem or terminal. Figure 5-1 gives an algorithm for finding the source of errors.

If you have any further questions or problems, please contact your dealer.

6- APPLICATION EXAMPLES

6.1 Dialing a Remote Modem

Command line: ATDP9WT002, (886)-7128423<CR>

This command line instruct the modem to dial a remote modem through a PBX. The modem first use pulse dialing to dial 9 (the access mde of the PBX), wait for outside dial tone, and then use touch tone dialing to dial 002 once a one-second continuous dial tone is detected within 30 seconds, pause for 2 seconds (if S8=2) and then dial 8867128423.

6.2 Dial a Stored Number

Command line: AT&Z2=T03,709394<CR>

Command line: ATDS=2<CR>

The first command line store the dial string T03, 709394 to the 3rd location in NVRAM. Afterwards you can use the second command line to dial this stored number. The dial string T03, 709394 will appear on the screen to indicate the number being dialed.

6.3 Manual Answer an Incoming Call

Command line: ATA <CR>

The factory setting of the S-register So is S0=0. This condition disables the auto answer capability so that you must issue an ATA command to answer a call. At power up, your modem always monitors if there are incoming rings. If incoming rings are detected, your modem will display result codes on the screen as:

RING

RING

Seeing that, you may issue the ATA command to answer the call. This command must be entered within the quiet interval between any two rings.

6.4 Auto Answer an Incoming Call

Command line: AT S0=2 &W &Y <CR>

Auto answer can be enabled by changing the setting of the S-register SO to a value between 1 and 255. In the above command line, S0=2 instructs the modem to answer an incoming call automatically after the 2nd ring. The &W command writes this configuration to profile 0 in NVRAM. &Y command instruct the modem to load profile 0 as the active configuration on power-up. The last two commands make S0=2 the default value at power-up or reset.

This example also shows the insertion of space between two neighboring commands to make the command line more readable.

6.5 Voice to Data Switching

Command line: ATA <CR> or ATX1D <CR>

If you are talking with a remote modem user through the telephone set and want to initiate data communication with the remote modem, follow the procedure below:

1. You or the remote user issue an ATA command first to switch to data communication.

2. When the person on the other end hears an answer tone from the phone, issues an ATX1D command (X1 to disable the dial tone monitor) to instruct the modem to go off-hook and wait for a carrier. If connection is successful, the CONNECT XXXX result code will be displayed on the screen, Now you can hang up your phone and begin data communication with the remote modem.

A - TECHNICAL SPECIFICATIONS

A.1 Features

Speeds

(bps) 300, 1200, 2400, 4800, 7200, 9600, 12000, 14400 (plus 19200, 38400, 57600 in data mode only)

Protocols

(Data) CCITT:V.32 bis, V.32, V.22 bis, V.22, and V.21. Bell: 212A and 103

(Fax) CCITT V.17, V.29, V.27 ter, and V.21 ch 2

Error Checking 100% reliable data transfer with V.42 bis/MNP 5

Standards Enhanced 'AT' command set, Fax Class 1 command

Modulation

Data	14400 bps	TCM/QAM
	9600 bps	TCM/QAM
	4800 bps	QAM
	2400 bps	QAM
	1200 bps	PSK
	300 bps	FSK
Fax	14400 bps	QAM
	9600 bps	QAM
	7200 bps	QAM
	4800 bps	QAM
	2400 bps	QAM

Operation	Full-or Half-duplex 14400 bps with 9600,4800,2400, and 1200 bps auto fall-back
Test Modes	Analog loopback, local digital loopback, and remote digital loopback
Audio Monitor	Built-in speaker, with software-controllable volume control
Guard Tone	550/1800 Hz

Compatibility:

Data	CCITT V.32bis	14400/9600 bps, asynchronous
	CCITT V.32	9600/4800 bps, asynchronous
	CCITT V.22 bis	2400/1200 bps, asynchronous
	CCITT V.22	1200 bps, asynchronous
	CCITT V.21	300 bps, asynchronous
	Bell 212A	1200 bps, asynchronous
	Bell 103	300 bps, asynchronous
Fax	CCITT V.17	14400/9600 bps, half-duplex
	CCITT V.29	9600/7200 bps, half-duplex
	CCITT V.27 ter	4600/2400 bps, half-duplex
	G - III	(Group 3 fax)

Compliance **FCC 15&68**

Command Buffer **40 characters**

Extra Memory **4 x 36 digits**

Transmit Level **-11(+/-1)dBm**

Receive Sensitivity **-40dBm**

Pulse Dialing Specifications

	USA	International
Make/Break Ratio	39/61	33/67
Break Length	61ms	67ms
Dial Pulse Length	100m	100ms
Dial Pulse Rate	1 Opps	10pps
Interdigit Time	800ms	800ms

B - Quick Reference

Basic Data Modem 'AT' Commands

Command		Default	Function
A/	**	none	Repeat last command
A		none	Answer
Bn	*	1	Select CCITT or Bell
Cn		1	Carrier control option
D		none	Dial command
En	*	1	Command echo
Fn		1	On-line echo
Hn		0	Switch hook control
In		0	Identification/checksum
Kn		none	SRAM buffer control
Ln	*	2	Speaker volumn control
Mn	*	1	Speaker control
Nn	*	1	Connection data rate control
On		0	Go on line
P	*	none	Select pulse dialing
Qn	*	0	Result code display control
Sn		none	Select an S-register
Sn=x		none	Write to an S-register
Sn?		none	Read from an S-register
?		none	Read last accessed S-register
T	*	none	Select DTMF dialing

Command		Default	Function
Vn	*	1	Result code form
Xn	*	4	Result code type
Yn	*	0	Long space disconnect
Zn		0	Recall stored profile
&Cn	*	1	DCD option
&Dn	*	2	DTR option
&F		none	Load factory defaults
&Gn	*	o	Guard tone option
&Jn	*	0	Auxiliary relay control
&Ln		0	Dial-up/leased line option
&Mn	*	0	Communication mode option
&Pn	*	0	Dial pulse ratio
&Qn	*	0	Communication mode option
8Sn	*	0	DSR option
&Tn		0	Self test commands
&Vn		0	View active and stored configuration
&Un	*	0	Disable Trellis coding
&Wn		0	Stored active profile
&Xn		0	Sync transmit clock source option
&Yn	*	0	Select stored profile on power up
&Zn=x		none	Store telephone number
%En	*	1	Auto-retrain control
%Gn	*	0	Rate Renegotiation
%Qn		none	Line signal quality
-Cn	*	0	Generate data modem calling tone

* Value saved in NVRAM

** Command not preceded by an 'AT'.

V.42, MNP 'AT' Commands

Command		Default	Function
%An	*	13	Set auto-reliable fallback character
%Cn	*	1	MNP 5 data compression control
\An	*	3	MNP block size
\Bn		none	Transmit break
\Cn	*	0	Set auto-reliable buffer
\Gn	*	0	Set modem port flow control
\Jn	*	0	Bps rate adjust control
\Kn	*	5	Set break control
\Nn	*	3	Set operating mode
\O		none	Originate reliable link
\Qn	*	3	Set serial port flow control
\Tn	*	0	Set inactivity timer
\U		none	Accept reliable link
\Vn	*	2	Modify result code form
\Xn	*	0	Set XON/XOFF pass-through
\Y		none	Switch to reliable mode
\Z		none	Switch to normal mode
-Jn	*	1	Set V.42 detect phase
*Hn	*	3	V.42 bis compression control
*On		16	V.42 bis string length

* Value saved in NVRAM.
** Command not preceded by an 'AT'.

Dial Modifiers

Command	Function
0 to 9	Dialing digits
A, B, C, D,*,#	Tone dial characters
P	Pulse dial
R	Reverse originate mode
S=n	Dial NVRAM telephone number
T	Tone dial
W	Wait for dial tone
,	Pause
!	Flash hook
@	Wait for quiet answer
;	Return to idle state
- ( )	Ignored by modem

C - ASCII CODE TABLE

Decimal	Hex	Value	Decimal	Hex	Value	Decimal	Hex	Value	Decimal	Hex	Value
000	00	NUL	032	20	(space)	064	40	@	096	60	'
001	01	SOH	033	21	!	065	41	A	097	61	a
002	02	STX	034	22	"	066	42	B	098	62	b
003	03	ETX	035	23	#	067	43	C	099	63	c
004	04	EOT	036	24	$	068	44	D	100	64	d
005	05	ENQ	037	25	%	069	45	E	101	65	e
006	06	ACK	038	26	&	070	46	F	102	66	f
007	07	BEL	039	27	'	071	47	G	103	67	g
008	08	BS	040	28	(	072	48	H	104	68	h
009	09	HT	041	29	)	073	49	I	105	69	i
010	0A	LF	042	2A	*	074	4A	J	106	6A	j
011	0B	VT	043	2B	+	075	4B	K	107	6B	k
012	0C	FF	044	2C	,	076	4C	L	108	6C	l
013	0D	CR	045	2D	-	077	4D	M	109	6D	m
014	0E	SO	046	2E	.	078	4E	N	110	6E	n
015	0F	SI	047	2F	/	079	4F	O	111	6F	o
016	10	DLE	048	30	0	080	50	P	112	70	p
017	11	DC1	049	31	1	081	51	Q	113	71	q
018	12	DC2	050	32	2	082	52	R	114	72	r
019	13	DC3	051	33	3	083	53	S	115	73	s
020	14	DC4	052	34	4	084	54	T	116	74	t
021	15	NAK	053	35	5	085	55	U	117	75	u
022	16	SYN	054	36	6	086	56	V	118	76	v
023	17	ETB	055	37	7	087	57	W	119	77	w
024	18	CAN	056	38	8	088	58	X	120	78	x
025	19	EM	057	39	9	089	59	Y	121	79	y
026	1A	SUB	058	3A	:	090	5A	Z	122	7A	z
027	1B	ESC	059	3B	;	091	5B	[	123	7B	{
028	1C	FS	060	3C	<	092	5C	\	124	7C	|
029	1D	GS	061	3D	=	093	5D	]	125	7D	}
030	1E	RS	062	3E	>	094	5E	^	126	7E	~
031	1F	US	063	3F	?	095	5F	_	127	7F	DEL